NON-PUBLIC?: N
ACCESSION #: 9301210168
LICENSEE EVENT REPORT (LER)

FACILITY NAME: Pilgrim Nuclear Power Station PAGE: 1 OF 11

DOCKET NUMBER: 05000293

TITLE: Automatic Scram Resulting From Load Rejection at 48
Percent Reactor Power
EVENT DATE: 12/13/92 LER #: 92-016-00 REPORT DATE: 01/11/93

OTHER FACILITIES INVOLVED: N/A DOCKET NO: 05000

OPERATING MODE: N POWER LEVEL: 48

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10
CFR SECTION:
50.73(a)(2)(iv)

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COMPONENT FAILURE DESCRIPTION:
CAUSE: SYSTEM: COMPONENT: MANUFACTURER:
REPORTABLE NPRDS:

SUPPLEMENTAL REPORT EXPECTED: No

ABSTRACT:

On December 13, 1992, at 1723 hours, an automatic scram resulting from a load rejection occurred while at 48 percent reactor power. The load rejection included a trip of the Main Turbine, closure of the Turbine Control Valves and opening of the Bypass Valves, and automatic transfer of the Auxiliary Power Distribution System.

The load rejection was most likely caused by 345 KV switchyard flashovers due to salt deposited during a severe coastal storm. Corrective actions taken included a washdown of the switchyard after the storm winds subsided and repairing of damaged insulation on a conductor from the current transformer. The unit returned to commercial service on December 18, 1992, at 1350 hours.

This event occurred during power operation while at 48 percent reactor power. The reactor mode selector switch in the RUN position. The Reactor Vessel (RV) pressure was 955 psig with RV water temperature at 540 degrees Fahrenheit. This report is submitted in accordance with 10 CFR 50.73(a)(2)(iv) and this event posed no threat to the public health and safety.

END OF ABSTRACT

BACKGROUND

A period of sustained easterly onshore winds began on December 10, 1992, and continued through December 14, 1992. The winds were due to a severe

northeast coastal storm. The winds were accompanied by heavy coastal rains until early on December 13, 1992. Moreover, the winds were accompanied by snow accumulations that began near the coast and quickly increased with distance from the coast. Intermittent electrical power outages occurred in some offsite transmission systems and offsite emergency conditions were declared by Commonwealth of Massachusetts officials due to some coastal flooding and snow-related effects of the storm.

Seaweed was transported to the Intake Structure as a result of the winds and lunar tides. Operation of the traveling screens that are part of the Circulating Water System was necessary because of the seaweed. The Main Condenser vacuum gradually degraded as a result of the carryover of some of the seaweed onto the Main Condenser tube sheets and increased Circulating Water pump motor currents were also noted. Reactor power was reduced to backwash the Main Condenser on December 11, 1992.

On December 12, 1992, reactor power was again reduced to backwash the Main Condenser. Prior to completing the backwash, the switchyard 345 KV air type circuit breakers (ACBs) 102 and 105 tripped open. This removed 345 KV transmission line 355 from service. The 345 KV transmission line 342 remained in service with ACBs 103 and 104 closed. Located at the end of this report is a figure depicting a simplified, single line diagram of the 345 KV switchyard, including the ACBs and transmission lines.

The backwash was completed and a reactor power increase was initiated at 1055 hours. At 1208 hours the regional power authority (REMVEC) requested a power reduction. By 1323 hours, reactor power had been reduced to 37 percent and was being held at that level pending further instruction from REMVEC. At 1331 hours, Emergency Diesel Generator (EDG) 'A' was started and the source of power to 4160 VAC emergency Bus A5 was transferred from

the Unit Auxiliary Transformer (UAT) to EDG 'A'. At 1335 hours, EDG 'B' was started and the source of power to 4160 VAC emergency Bus A6 was transferred from the UAT to EDG 'B'. These actions were taken in acco
dance with Procedure 2.4.144 (Rev. 9), "Degraded Voltage" and in accordance with the guidance provided in procedure 5.2.2 (Rev. 15), "High Winds". Another Main Condenser backwash was initiated at 1336 hours and was completed at 1534 hours. At 1955 hours, REMVEC requested a 45 MWe power increase. After the increase, the source of power to Bus A5 was shifted from EDG 'A' to the UAT at 2015 hours. After the shutdown, the belt for the EDG 'A" belt driven fuel pump was discovered broken and EDG 'A' was declared inoperable due to the broken fuel pump belt. Subsequent investigation revealed the belt failure occurred during service and did not occur during the start of EDG 'A'.

The source of power to Bus A6 was transferred from EDG 'B' to the UAT and EDG 'B' was returned to standby service at 2019 hours. EDG 'B' was started at 2036 hours and loaded onto Bus A6 for surveillance testing because EDG 'A' was inoperable. A Main Condenser backwash was initiated and completed by 2230 hours. At 2235 hours, EDG 'B' was returned to normal standby service.

On December 13, 1992, at 0410 hours, a Main Condenser backwash was initiated and was completed at 0615 hours. At 0517 hours, EDG 'A' was started for post work testing (fuel pump belt replaced). EDG 'A' was returned to standby service at 0713 hours and declared operable at 1142 hours. By 0840 hours, 345 KV transmission line 355 was returned to service with ACBs 102 and 105 closed. At 1700 hours, a power reduction began for

another Main Condenser backwash.

EVENT DESCRIPTION

December 13, 1992 at 1723 hours, an unplanned automatic Reactor Protection System (RPS) scram signal and scram occurred while at 48 percent reactor power. The scram signal occurred as a result of a generator load rejection that included a trip of the Turbine-Generator. The event was initiated when ACB's 102, 104 and 105 opened isolating the Main Transformer from the two 345 KV outlet transmission lines.

The Turbine trip (MTS-1) included the following responses:

o Automatic transfer of the source of 4160 VAC power for the Auxiliary Power Distribution System (APDS), including Bus A5 and Bus A6, from the UAT to the Startup Transformer (SUT).

o Automatic closing of the Turbine Stop Valves and Combined Intermediate Valves, and the trip of the Turbine lockout relay (286-2).

o Closure of the four Turbine Control Valves and the sequential opening of the three Turbine Bypass Valves.

o Loss of oil. pressure to pressure switches (PS-37/38/39/40) that resulted in the RPS scram signal (load reject).

As expected, the RV water level decreased in response to the scram due to a decrease in the void fraction in the RV water. The RV water level eventually decreased to approximately -2 inches. The decrease in RV

water level, to less than the low RV water level setpoint (calibrated at approximately inches) resulted in automatic actuations of the Primary Containment Isolation Control System (PCIS) and Reactor Building Isolation Control System (RBIS).

The PCIS actuation resulted in the following designed responses:

o Automatic closing of the inboard and outboard Primary Containment System (PCS)/Reactor Water Sample isolation valves AO-220-44 and -45.

o Automatic closing of the inboard and outboard PCS Group 2 (two) isolation valves that were open.

o The PCS Group 3 (three)/Residual Heat Removal System isolation valves, in the closed position, remained closed.

o Automatic closing of the inboard and outboard PCS Group 6 (six)/Reactor Water Cleanup (RWCU) System isolation valves and interruption in RWCU System operation.

The RBIS actuation resulted in the automatic closing of the Reactor Building/Secondary Containment System (SCS) trains 'A' and 'B' supply and exhaust ventilation dampers and automatic start of the SCS/Standby Gas Treatment System (SGTS) trains 'A' and 'B'.

Initial Control Room operator response was orderly and included the following. The reactor mode selector switch was moved from the RUN

position to the SHUTDOWN position and the reactor feedpumps were tripped in accordance with procedure 2.1.6, "Reactor Scram". Emergency Operating Procedure EOP-01, "RPV Control", was initiated at 1724 hours when the RV water level decreased to less than inches and was terminated at 1729 hours when the RV water level increased to greater than inches. Procedures 2.1.5 Attachment 1, "Shutdown/Cooldown Checklist", and 2.1.7 Attachment 1, "RPV Temperature and Pressure Checklist" were initiated. The RPS was reset at 1738 hours. The PCIS circuitry was reset, the RBIS circuitry was reset, the SGTS was returned to normal standby service, and the Reactor Building ventilation system was returned to normal service.

At 1800 hours, ACB 102 tripped open and automatically reclosed. At 1803 hours, the ACB 102 automatic reclosure feature was tagged OFF per REMVEC instructions.- The backwash of the Main Condenser was completed, at 1914 hours.

On December 14, 1992, at 0130 hours, ACBs 104 and 105 were closed with the main disconnects (T930) in the open position. At 0218 hours, ACBs 102 and 105 opened and line 355 de-energized. At 0231, line 355 was re-energized by REMVEC. At 0234 hours, ACB 102 was reclosed per REMVEC instructions. At 0242 hours, ACB 102 tripped open and removed line 355 as a source of power to the SUT.

At 0330 hours, the Recirculation System Loop 'A' motor-generator (MG) set/pump was removed from service and the Residual Heat Removal (RHR) System Loop 'A' was put into service in the Shutdown Cooling (SDC) mode with one pump in service. At 0430 hours, the Recirculation System Loop 'B' MG set/pump was removed from service and the RHR System Loop 'B' was

put into service in the SDC mode with one pump in service.

At 0450 hours, ACBs 102 and 105 were reclosed per REMVEC instructions. At 0615 hours, EDGs 'A' and 'B' were synchronized to Bus A5 and Bus A6, respectively, and the SUT was removed as the source of power to Bus A5 and Bus A6.

Cold shutdown was achieved at approximately 0630 hours when the RV water temperature was less than 212 degrees Fahrenheit and the RV head vent valves were subsequently opened.

Problem Report 92.9277 was written to document the event. The NRC Operations Center was notified of the event in accordance with 10 CFR 50.72 on December 13, 1992, at 1812 hours.

This event occurred during power operation with the reactor mode selector switch in the RUN position. The Reactor Vessel (RV) pressure was 955 psig with the RV water temperature at approximately 540 degrees Fahrenheit. The Turbine first stage pressure was approximately 300 psig.

CAUSE

A post trip review of the event was performed in accordance with procedure 1.3.37 (Rev. 7), "Post Trip Reviews". A team was formed to analyze and determine the root cause of the event.

The 345 KV transmission system (lines 342 and 355), 345 KV switchyard, Main Transformer, and Startup Transformer (SUT) are equipped with protective primary and secondary relaying.

Main Transformer Secondary relays 21/MT and 86Y/MT actuated, initiating the opening of ACBs 104 and 105, Main Turbine Trip and Lockout, resulting in a load rejection scram. The exact sequence of switchyard protective relay actuations and ACB openings is indeterminate because no events recorder is installed for the relays and a plant computer (EPIC) power supply module experienced a problem that affected the recording of breaker opening times during this event. Because ACB 102, 104 and 105 all opened, this could occur either by two (2) faults within one second in the switchyard or a single fault combined with the failure in the operation of relay 21/MT.
One fault was visually confirmed when-evidence of arcing was noted on three bushings located on the 345 KV 'C' phase busbar located between ACB 102 and 105. A single fault at this location should not result in the opening of ACB 104 and 105.

Based on offsite Supervisory Control and Data Acquisition Monitoring equipment data, substation event recorders (located at Bridgewater and West Medway) and targets for PNPS relays (67N/L1, 21P/L1, 21-1/L1, 21/MT, Lockout Relay 86Y/MT), indicated trip signals were sent to ACB 102, 104 and 105 at the beginning of the event.

The target for relay 21/MT (Main Transformer Directional Distance Relay) was received and the Main Transformer Secondary Lockout Relay (86Y/MT) tripped. These actions indicate either misoperation of relay 21/MT or a fault occurring between ACB 104 and 105 and the Main Transformer.
Extensive testing of the 21/MT relay and its circuitry was performed.
Relay calibration was checked and found within tolerance. Relay scheme wiring was verified to be per design drawings.

Damaged insulation was found on one of the conductors for the 'C' phase current transformer supplying the 21/MT relay (Westinghouse type KD4). This condition could have caused a failure in the operation of the 21/MT relay. However, this condition was analyzed by Boston Edison's relaying engineering personnel and determined to be an unlikely cause for this event. A flashover at the Main Transformer high side bus is considered to be the most probable cause, but this can not be positively determined due to the lack of available information.

CORRECTIVE ACTION

After storm winds had subsided, the switchyard was walked down for evidence of flashover. Evidence of arcing was noted on three bushings located on the 'C' phase busbar located between ACB 102 and 105. The bushings were hand cleaned and washed down. The switchyard was washed down to remove salt deposits.

Proper setpoint calibration was verified for relays Overcurrent Fault Detector Relay 50/MT, Directional Distance Relay 21/MT and Directional Ground Overcurrent Relay 67N/MT. Wiring of the Main Transformer Secondary relay schemes was verified to ensure proper installation per design drawings of Relay 21/MT.

The unit returned to commercial service on December 18, 1992, at 1350 hours.

On December 20, 1992, with the plant at 48 percent power, on-line te
ting

of the 21/MT relay was performed to verify proper polarity. The results of the test showed the polarity to be correct. However, unbalanced phase currents were observed. Subsequent investigation performed while shutdown as a result of an unrelated scram on December 20, 1992, located a pinched conductor on the 'C' phase Secondary Main Transformer relaying current transformer circuit. The damaged insulation was repaired and on-line testing was repeated on December 30, 1992, at 100 percent power. The test results indicated proper polarity and balanced phase currents at the 21 /MT relay.

PREVENTIVE ACTION

The switchyard events recorder has been removed and a replacement recorder to monitor voltages, currents, and ACB positions, should be installed. This will aid in future troubleshooting during switchyard events.

Procedure 3.M.3-39 "Turbine Generator Lockout Relays Trip Test", will be revised to include functional testing of Main Transformer Relays 21/MT, 50/MT, 87/MT and 67N/MT.

The mechanism of and possible solution to switchyard salt deposits/buildup will be evaluated. This is the second plant trip caused by flashover since the insulators were treated with a Sylgard covering in the summer of 1987. Since that treatment, a significant reduction in insulator corona during adverse weather conditions has been noted.

SAFETY CONSEQUENCES

This event posed no threat to the public health and safety.

The load rejection with bypass experienced during this event is bounded by the transient analysis described in the Updated Final Safety Analysis Report section 14.4.3, "Generator Load Rejection Without Bypass". The opening of some of the Main Steam two-stage relief valves is an expected response to a load rejection with bypass at greater than 45 percent power. For this event none of the relief valves opened.

The Technical Specification 2.2.B limiting safety system setting for the Main Steam System/Pressure Relief System (PRS) relief valves is 1095 to 1115 psig with a tolerance of 11 psi. The setpoint of the relief valves is 1115 psig. Therefore, the setpoint range of the relief valves including tolerance is 1104 psig to 1126 psig. During the event, the highest RV/Main Steam System pressure that occurred was approximately 985 psig.

The Technical Specification 2.2.C limiting safety system setting for the Main Steam/PRS safety valves is 1240 13 psi. During the event, the highest RV pressure that occurred was approximately 255 psig less than the safety valves' setpoint of 1240 psig.

The scram signal was the designed response to a load rejection with the Turbine first stage pressure at approximately 300 psig, greater than the scram bypass setpoint (calibrated at 108 psig 3 psig) corresponding to 25 percent of the normal first stage pressure. The maximum turbine speed that occurred was 1840 rpm and was less than the speed corresponding to the emergency trip setting of 1980 rpm.

The decrease in the RV water level was the expected response to the scram

and accompanying shrink in the RV water. The PCIS and RBIS actuations were the expected designed responses to a low RV water level condition, (i.e., inches).

The Technical Specification 2.1.I limiting safety system setting for actuation of the Core Standby Cooling Systems (CSCS) is -49 inches. During the event, the lowest RV water level that occurred (-2 inches) was approximately 44 inches above the CSCS setpoint. In addition, the level was approximately 125.5 inches above the level that corresponds to the top of the active fuel zone.

This report is submitted in accordance with 10 CFR 50.73 (a)(2)(iv) because the actuation of the RPS, although an expected designed response to the load rejection at 48 percent reactor power, was not planned.

SIMILARITY TO PREVIOUS EVENTS

A review was conducted of Pilgrim Station Licensee Event Reports (LERS) submitted since January 1984. The review focused on LERs submitted in accordance with 10 CFR 50.73(a)(2)(iv) that involved a load rejection or similar scram. The review identified similar events reported in LERs 50-293/85-025-00, 89-026-00, 90-008-00, and 91-024-00.

For LER 85-025-00, an automatic scram occurred on September 1, 1985, at 0521 hours while at 32 percent reactor power. At the time of the event, the Main Condenser was being backwashed and a live washdown of the 345 KV switchyard insulators was being performed to reduce arcing due to salt from a heavy ocean storm. A 345 KV phase 'B' insulator, located on the Main Transformer side of ACB 104, disintegrated and resulted in a load rejection. The cause for the scram was high RV pressure that resulted from

the load rejection. The cause for the event was due to the forces of nature (i.e., high winds and salt air). Please note that the event occurred while at 32 percent reactor power. At that power level, the Turbine first stage pressure was approximately 200 psig.

An RPS scram signal due to a Turbine Control Valves Fast Closure or Turbine Stop Valves closure would have occurred if the Turbine first stage pressure had been greater than approximately 280 psig, the scram bypass setpoint for 45 percent of the normal first stage pressure. The scram bypass setpoint was changed from 280 psig to 108 psig via modification PDC 87-48 during Refueling Outage Number 7.

For LER 89-026-00, an automatic scram occurred on August 30, 1989, at 1917 hours while at 65 percent reactor power. The cause for the scram signal was high RV pressure (ultimately 1069 psig) that occurred as a result of an automatic Turbine runback. The runback included the automatic adjustment of the Turbine Control Valves and sequential opening of the Turbine Bypass Valves. The runback occurred as a result of the failure of the primary winding of the Main generator 24 KV phase 'A' potential transformer and a Generator Voltage Balance Relay wiring error that affected the transfer function of the Generator's Voltage Regulator. The wiring error was due to a drawing error. The error was not previously detected because the surveillance test procedure (3.M.3-39) used to functionally test the relay, although demonstrating the voltage balance relay functions and alarm functions, did not include a step to identify the auxiliary relay that actuates the same alarm (Panel C-3R, "Generator Potential Fuse Blown").

For LER 90-008-00, an automatic scram due to a load rejection occurred on May 13, 1990, at 1603 hours, while at 100 percent reactor power. The load rejection was caused by a momentary fault on the offsite 345 KV transmission system. The Generator's loss of field relay 240 detected the fault and immediately tripped the Generator without an expected 15 cycle time delay because one of it's components, the telephone relay coil, was defective. The relay had been calibrated and functionally tested on October 26, 1989. At that time, the operation of the coil was tested in accordance with the vendor manual. The relay's time delay was built-in and not adjustable, and was not required to be timed. The relay was installed during plant construction (c. 1972). The cause for the open coil was investigated and believed to be a random or age-related failure. The relay is the only one of its type (Westinghouse type KLF-1) installed at Pilgrim Station and was replaced with another type KLF-1 relay having an adjustable time delay. The relay's calibration sheet was revised to include a calibration of the adjustable time delay.

For LER 91-024-00, a loss of preferred offsite 345 KV power occurred while shut down on October 30, 1991, at 1942 hours, during a severe coastal storm (i.e., a northeaster). The loss of preferred offsite power occurred about two and one-half hours after a shutdown. The loss of preferred offsite power resulted in designed responses including automatic actuations of the RPS, PCIS, RBIS, and EDGs 'A' and 'B'. The cause of the loss of preferred offsite power was the flashover of a 345 KV switchyard ACB 104 insulator column and separate operation of a stuck breaker circuit.The flashover was the result of environmental conditions (i.e., salt deposited on the insulator) due to a period of sustained dry northeasterly onshore winds. The storm that produced the dry winds was rare but more noteworthy was the

period of sustained dry northeasterly onshore winds. The flashover caused switchyard ACBs 103, 104 and 105 to open. ACB 102 opened about 1.4 seconds later (stuck breaker circuit) even though ACB 105 opened as designed. The most probable cause of the stuck breaker circuit operation was 345 KV electrical noise coupled into the stuck breaker circuit. Corrective actions taken included a washdown of switchyard insulators and the installation of a high speed recorder to monitor the ACB 105 circuitry.
A loss of the secondary source of offsite power occurred at 1953 hours and an Unusual Event was declared at 2003 hours. The cause of the loss of 23KV secondary offsite power was also storm related when a tree fell onto a 23 KV line. Preferred offsite power was restored at 2142 hours and the Unusual Event was terminated at 2230 hours.

ENERGY INDUSTRY IDENTIFICATION SYSTEM (EIIS) CODES

The EIIS codes for this report are as follows:

COMPONENTS CODES

Insulator INS
Relay, Distance (21/MT) 21
SYSTEMS

Containment Isolation Control System (PCIS, RBIS) JM
Engineered Safety Features Actuation System JE
(PCIS, RBIS, RPS)
Main Steam System SB
Main Turbine System TA
Plant Protection System (PRS) JC
Reactor Water Cleanup (RWCU) System CE

Standby Gas Treatment System (SGTS) BH
Switchyard System (345 KV) FK

Figure omitted.

10 CFR 50.73

BOSTON EDISON

Pilgrim Nuclear Power Station
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E. Thomas Boulette, PhD January 11, 1993
Vice President Nuclear Operations BECo Ltr. 93-001
and Station Director

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D.C. 20555

Docket No. 50-293
License No. DPR-35

The enclosed Licensee Event Report (LER) 92-016-00, "Automatic Scram Resulting From Load Rejection at 48 Percent Reactor Power," is submitted

in accordance with 10 CFR Part 50.73.

Please do not hesitate to contact me if there are any questions regarding this report.

E. T. Boulette
Senior Vice President Nuclear (Acting)

RAG/bal

Enclosure: LER 92-016-00

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